MAPS Use the map of Maine shown and a customary ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.

1. Bangor and Portland

SOLUTION:

Using the map provided, the distance between Bangor and Portland in the map is about 0.93 in.

Write a proportion. Let *x* represent the distance between Bangor and Portland. Solve for *x*.

$$\frac{1\text{in}}{125\text{mi}} = \frac{0.94\text{in}}{x\text{ mi}}$$
$$\frac{1}{125} = \frac{0.94}{x}$$
$$x = 0.94 \cdot 125$$
$$x = 117.5$$

The distance between Bangor and Portland is about 117 mi.

ANSWER:

about 117 mi

2. Augusta and Houlton

SOLUTION:

Using the map provided, the distance between Augusta and Houlton in the map is about 1.25 in.

Write a proportion. Let *x* represent the distance between Augusta and Houlton. Solve for *x*.

$$\frac{1\text{in}}{125\text{mi}} = \frac{1.25\text{in}}{x\text{mi}}$$

$$\frac{1}{125} = \frac{1.25}{x}$$

$$x = 125 \cdot 1.25$$

$$x = 156.25$$

The distance between Augusta and Houlton is about 156 mi.

ANSWER:

about 156 mi

3. **SCALE MODELS** Carlos made a scale model of a local bridge. The model spans 6 inches; the actual bridge spans 50 feet.

a. What is the scale of the model?

b. What scale factor did Carlos use to build his model?

SOLUTION:

a. The scale of the model is the ratio of the length of the model to the actual length of the bridge. So, the scale of the model is 6 in : 50 ft.

b. The scale factor is $\frac{6\text{ in}}{50\text{ ft}}$.

Convert ft to in.

50 ft = 50 · 12 in = 600 in

Simplify the ratio.

$$\frac{6\text{ in}}{50\text{ ft}} = \frac{6\text{ in}}{600\text{ in}} = \frac{1}{100}$$

Carlos used a scale factor of $\frac{1}{100}$.

ANSWER:

a. 6 in. : 50 ft

b. $\frac{1}{100}$

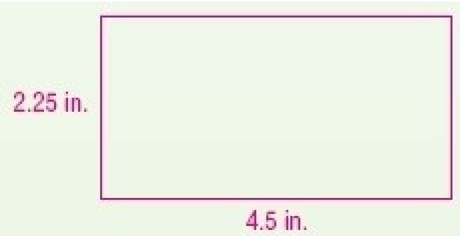
4. **SPORTS** A volleyball court is 9 meters wide and 18 meters long. Choose an appropriate scale and construct a scale drawing of the court to fit on a 3-inch by 5-inch index card.

SOLUTION:

To allow a scale model of the court to fit on a 3 by 5 index card, you will need to come up with a scale factor in which the dimensions fit in this range. Start by writing the scale factor as a fraction, then reducing the numerator and denominator by the same value until both fall within the 3 by 5 range.

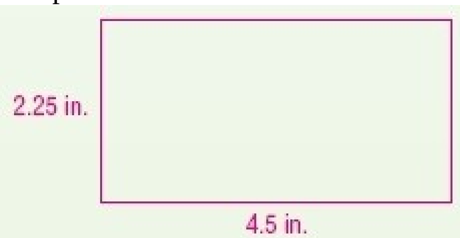
$$\frac{9 \div 3}{18 \div 3} = \frac{3}{6}\text{; too big}$$
$$\frac{9 \div 3.5}{18 \div 3.5} = \frac{2.6}{5.1}\text{; too big}$$
$$\frac{9 \div 4}{18 \div 4} = \frac{2.25}{4.5}\text{; it fits!}$$

Since we divided by 4, a scale factor we could use is 1 in. = 4 m



ANSWER:

Sample answer: 1 in. = 4 m



MAPS Use the map of Oklahoma shown and a metric ruler to find the actual distance between each pair of cities. Measure to the nearest centimeter.

5. Guymon and Oklahoma City

SOLUTION:

On the map provided, the distance between Guymon and Oklahoma City is about 5.7 in.

Write a proportion. Let *x* be the actual distance between Guymon and Oklahoma City. Solve for *x*.

$$\frac{1.5}{100} = \frac{5.7}{x}$$
$$1.5x = 570$$
$$x = 380$$

The distance from Guyman and Oklahoma City is about 380 km.

ANSWER:

380 km

6. Lawton and Tulsa

SOLUTION:
Using the map provided, the distance between Lawton and Tulsa is about 4.2 in.

Write a proportion. Let *x* be the actual distance between Lawton and Tulsa. Solve for *x*.

$$\frac{1.5}{100} = \frac{4.2}{x}$$

$$1.5x = 420$$

$$x = 280$$

The distance between Lawton and Tulsa is about 280 km.

ANSWER:
280 km

7. Enid and Tulsa

SOLUTION:
Using the map provided, the distance between Enid and Tulsa is about 2.6 in.

Write a proportion. Let *x* be the actual distance between Enid and Tulsa. Solve for *x*.

$$\frac{1.5}{100} = \frac{2.6}{x}$$

$$1.5x = 260$$

$$x \approx 173.33$$

The distance between Enid and Tulsa is about 173 km.

ANSWER:
173 km

8. Ponca City and Shawnee

SOLUTION:

Using the map provided, the distance between Ponca City and Shawnee is about 2.3 in.

Write a proportion. Let *x* be the actual distance between Ponca City and Shawnee. Solve for *x*.

$$\frac{1.5}{100} = \frac{2.3}{x}$$

$$1.5x = 230$$

$$x \approx 153.33$$

The distance between Ponca City and Shawnee is about 153 km.

ANSWER:

153 km

9. **SCULPTURE** A replica of *The Thinker* is 10 inches tall. A statue of *The Thinker* at the University of Louisville is 10 feet tall.

a. What is the scale of the replica?

b. How many times as tall as the actual sculpture is the replica?

Refer to Page 514.

SOLUTION:

a. To find the scale of the replica, find the ratio of the height replica to the height of the statue.

$$\frac{\text{height of the replica}}{\text{height of the statue}} = \frac{10\text{ in}}{10\text{ ft}} = \frac{1\text{ in}}{1\text{ ft}}$$

The scale of the replica is 1 in : 1 ft.

b. Convert the ratio to the same unit. We know 1 ft = 12 in, therefore

$$\frac{1\text{in}}{1\text{ft}} = \frac{1\text{in}}{12\text{in}}.$$

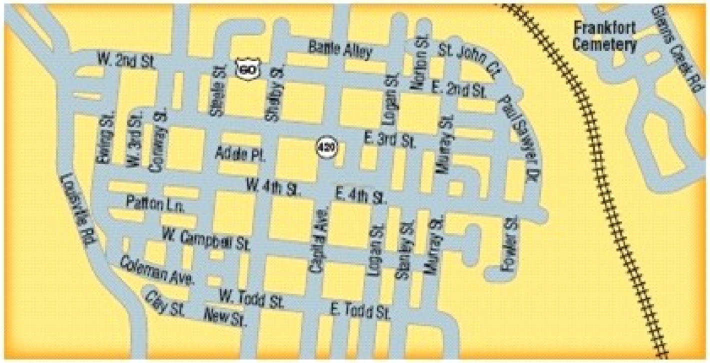
The replica is $\frac{1}{12}$ times as tall as the sculpture.

ANSWER:

a. 1 in. : 1 ft

b. $\frac{1}{12}$ times

10. **MAPS** The map below shows a portion of Frankfort, Kentucky.



a. If the actual distance from the intersection of Conway Street and 4th Street to the intersection of Murray Street and 4th Street is 0.47 mile, use a customary ruler to estimate the scale of the map.
b. What is the approximate scale factor of the map? Interpret its meaning.

SOLUTION:

a. While measuring the map in the student edition, the scale of the map is 1 in.: 0.25 miles.
b. While measuring the map in the student edition, the scale factor of the map is $\frac{1}{15,840}$. Sample answer: The map distance is $\frac{1}{15,840}$ of the actual distance; the actual distance is 15,840 times as long as the map distance.

ANSWER:

a. 1 in. :0.25 mi

b. $\frac{1}{15,840}$; Sample answer: The map distance is $\frac{1}{15,840}$ of the actual distance; the actual distance is 15,840 times as long as the map distance.

SPORTS Choose an appropriate scale and construct a scale drawing of each playing area so that it would fit on an 8.5-by-11-inch sheet of paper.

11. A baseball diamond is a square 90 feet on each side with about a 128-foot diagonal.

SOLUTION:

To allow a scale model of the baseball diamond to fit on a 8.5 by 11 sheet of paper, you will need to determine a scale factor in which each dimension fits within this range. Start by writing the scale factor as a fraction, then reducing the numerator and denominator by the same value until both fall within the 8.5 by 11 range.

$$\frac{90 \div 10}{128 \div 10} = \frac{9}{12.8}\text{; too big.}$$
$$\frac{90 \div 11}{128 \div 11} = \frac{8.2}{11.6}\text{; too big.}$$
$$\frac{90 \div 12}{128 \div 12} = \frac{7.5}{10.7}\text{; it fits!}$$

Since we divided by 12, a scale factor we could use is 1 in. = 12 ft

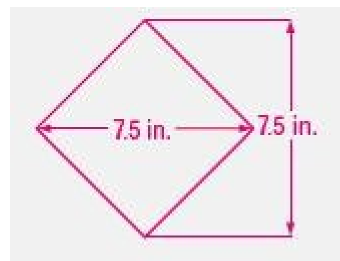


Figure not shown actual size.

ANSWER:

Sample answer: 1 in. = 12 ft

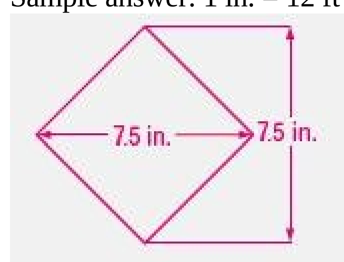


Figure not shown actual size.

12. A high school basketball court is a rectangle with length 84 feet and width 50 feet.

SOLUTION:

To allow a scale model of the basketball court to fit on a 8.5 by 11 sheet of paper, you will need to determine a scale factor in which each dimension fits within this range. Start by writing the scale factor as a fraction, then reducing the numerator and denominator by the same value until both fall within the 8.5 by 11 range.

$$\frac{50 \div 5}{84 \div 5} = \frac{10}{16.8}\text{; too big.}$$
$$\frac{50 \div 7}{84 \div 7} = \frac{7.1}{12}\text{; too big.}$$
$$\frac{50 \div 8}{84 \div 8} = \frac{6.25}{10.5}\text{; it fits!}$$

Since we divided the dimensions by 8, our scale factor is 1 inch: 8 feet.

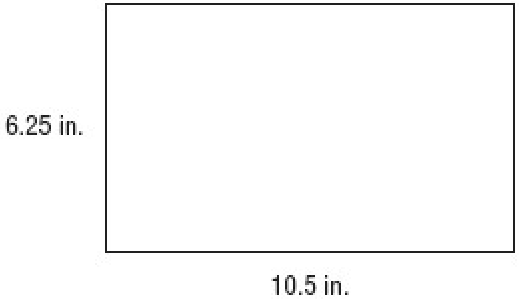


Figure not shown actual size.

ANSWER:

Sample answer: 1 in. = 8 ft

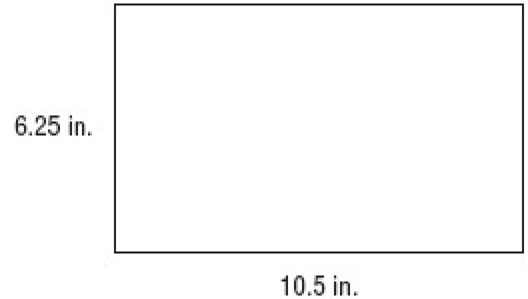


Figure not shown actual size.

MAPS Use the map shown and an inch ruler to answer each question. Measure to the nearest sixteenth of an inch and assume that you can travel along any straight line.

13. About how long would it take to drive from Valdosta, Georgia, to Daytona Beach, Florida, traveling at 65 miles per hour?

SOLUTION:

While using map provided, Valdosta and Daytona Beach are about $\frac{7}{8}$ of an inch apart. We can write a proportion to determine how many miles these cities are apart:

$$\frac{1\text{ inch on map}}{200\text{ real miles}} = \frac{\frac{7}{8}\text{ inch distance between the cities on the map}}{x\text{ real distance between the cities}}$$

$$\frac{1}{200} = \frac{\frac{7}{8}}{x}$$

$$200 \cdot \frac{7}{8} = x$$

$$175 = x$$

Therefore, the cities are 175 miles apart. We can determine the time it will take to drive there by using the distance/time/rate formula:

$$d = rt$$

$$175 = 65t$$

$$\frac{175}{65} = r$$

$$2.7 = r$$

It will take about 2.7 h or 2 h and 42 min to drive from Valdosta, Georgia, to Daytona Beach, Florida.

ANSWER:

about 2.7 h or 2 h and 42 min

14. How long would it take to drive from Gainesville to Miami, Florida, traveling at 70 miles per hour?

SOLUTION:

While using map provided, Gainesville and Miami are about $1\frac{1}{3}$ of an inch apart. We can write a proportion to determine how many miles these cities are apart.

$$\frac{1\text{ inch on map}}{200\text{ real miles}} = \frac{1\frac{1}{3}\text{ inch distance between the cities on the map}}{x\text{ real distance between the cities}}$$

$$\frac{1}{200} = \frac{1\frac{1}{3}}{x}$$

$$200 \cdot \frac{4}{3} = x$$

$$266.67 = x$$

Therefore, the cities are about 267 miles apart. We can determine the time it will take to drive there by using the distance/time/rate formula:

$$d = rt$$

$$267 = 65t$$

$$\frac{267}{65} = r$$

$$4.1 = r$$

While using provided map, it will take about 4.1 h or 4 h and 6 min to drive from Gainesville to Miami, Florida.

ANSWER:

about 4.1 h or 4 h and 6 min

At forty miles from Pluto to the Sun, the Maine Solar System Model on U.S. Route 1 is the largest complete three-dimensional scale model of the solar system in the world. Its scale factor is 1: 93,000,000

SCALE MODELS If the distance between Earth and the Sun is actually 150,000,000 kilometers, how far apart are Earth and the Sun in the model?

SOLUTION:

Write a proportion. Let *x* distance between Earth and the Sun in the model. Solve for *x*.

$$\frac{\text{distance between Earth and Sun (model)}}{\text{distance between Earth and Sun (actual)}} = \frac{1}{93,000,000}$$

$$\frac{x}{150,000,000} = \frac{1}{93,000,000}$$

$$93,000,000x = 150,000,000$$

$$x \approx 1.613$$

The distance between Earth and the Sun in the model is about 1.61 km.

ANSWER:

1.61 km

16. **LITERATURE** In the book, Alice's Adventures in Wonderland, Alice s size changes from her normal height of about 50 inches. Suppose Alice came across a door about 15 inches high and her height changed to 10 inches.

a. Find the ratio of the height of the door to Alice's height in Wonderland.

b. How tall would the door have been in Alice's normal world?

SOLUTION:

a. $\frac{\textit{height of door in Wonderland}}{\textit{Alice's height in Wonderland}} = \frac{15}{10} = \frac{3}{2}$

b. Let *x* be the unknown. Form a proportion and solve for *x*.

$$\frac{\textit{height of door in Wonderland}}{\textit{height of Alice in Wonderland}} = \frac{\textit{height of door in normal world}}{\textit{height of Alice in normal world}}$$

$$\frac{15}{10} = \frac{x}{50}$$

$$750 = 10x$$

$$x = 75$$

Therefore, the height of the door is about 75 inches in Alice's normal world.

ANSWER:

a. $\frac{3}{2}$

b. about 75 in.

17. **ROCKETS** Peter bought a $\frac{1 \text{ in.}}{12 \text{ ft}}$ scale model of the Mercury-Redstone rocket.

a. If the height of the model is 7 inches, what is the approximate height of the rocket?

b. If the diameter of the rocket is 70 inches, what is the diameter of the model? Round to the nearest half inch.

SOLUTION:

a. Let *x* be the approximate height of the rocket.

Form a proportion and solve for *x*.

$$\frac{1\text{ in (model)}}{12\text{ ft (real)}} = \frac{\text{height of model rocket}}{\text{height of rocket}}$$

$$\frac{1}{12} = \frac{7}{x}$$

$$x = 84$$

The height of the rocket is approximately 84 feet.

b. Let *x* be the diameter of the model. (12 feet = 144 inches)

Form a proportion and solve for *x*.

$$\frac{1\text{ in (model)}}{144\text{ in (real)}} = \frac{\text{diameter of model rocket}}{\text{diameter of rocket}}$$

$$\frac{1}{144} = \frac{x}{70}$$

$$144x = 70$$

$$x \approx 0.486$$

The diameter of the model rocket is approximately 0.5 inches.

ANSWER:

a. 84 ft
b. 0.5 in.

18. **ARCHITECTURE** A replica of the Statue of Liberty in Austin, Texas, is $16\frac{3}{4}$ feet tall. If the scale factor of the actual statue to the replica is 9:1, how tall is the actual statue in New York Harbor?

SOLUTION:

Let *x* be the height of the statue in New York Harbor.

Form a proportion and solve for *x*.

$$\frac{9\,ft}{1\,ft.} = \frac{height\ of\ the\ actual\ statue}{height\ of\ the\ replica}$$

$$\frac{9}{1} = \frac{x}{\left(16\frac{3}{4}\right)}$$

$$9 \cdot \frac{67}{4} = x$$

$$150.75 = x$$

The height of the statue in New York Harbor is about 151 feet.

ANSWER:

151 ft

19. **AMUSEMENT PARK** The Eiffel Tower in Paris, France, is 986 feet tall, not including its antenna. A replica of the Eiffel Tower was built as a ride in an amusement park. If the scale factor of the actual tower to the replica is approximately 3: 1, how tall is the ride?

SOLUTION:

Let x be the height of the ride.

Form a proportion and solve for x.

$$\frac{height\,of\,actual\,tower}{height\,of\,ride} = \frac{3}{1}$$

$$\frac{986}{x} = \frac{3}{1}$$

$$3x = 986$$

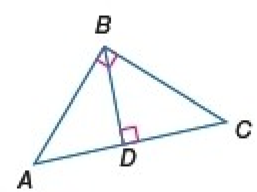
$$x \approx 328.67$$

So, the height of the ride is about 329 feet.

ANSWER:

329 ft

20. **MULTIPLE REPRESENTATIONS** In this problem, you will explore the altitudes of right triangles.



a. GEOMETRIC Draw right ΔABC with the right angle at vertex B. Draw altitude $\overline{BD}$. Draw right ΔMNP, with right angle N and altitude $\overline{NQ}$, and right ΔWXY, with right angle X and altitude $\overline{XZ}$.

b. TABULAR Measure and record indicated angles in the table below.

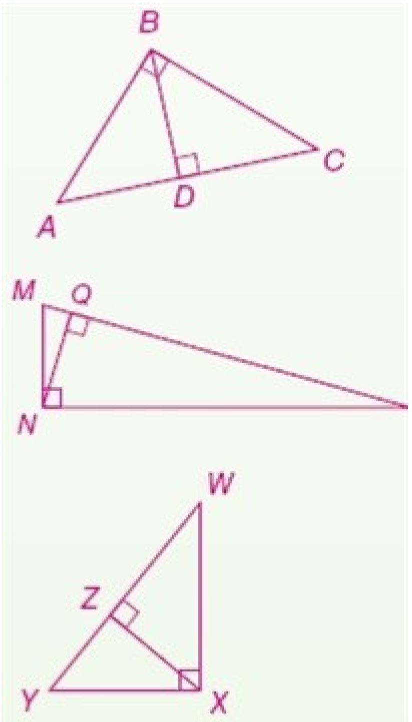
	Angle Measure					
	△ABC		△BDC		△ADB	
△ABC	ABC		BDC		ADB	
	A		CBD		BAD	
	C		DCB		DBA	
	△MNP		△NQP		△MQN	
△MNP	MNP		NQP		MQN	
	M		PNQ		NMQ	
	P		QPN		QNM	
	△WXY		△WZX		△XZY	
△WXY	WXY		WZX		XZY	
	W		XWZ		YXZ	
	Y		ZXW		ZYX	

c. VERBAL Make a conjecture about the altitude of a right triangle originating at the right angle of the triangle.

SOLUTION:

When drawing your triangles, it is important that you use a straight edge and a protractor, so that you measurements are accurate. Follow the directions carefully and label the triangles as directed.

Sample answer:



b. Carefully measure the angles of each triangle and record the measurements in the table below. Pay attention to any patterns you see.

Sample answer are given.

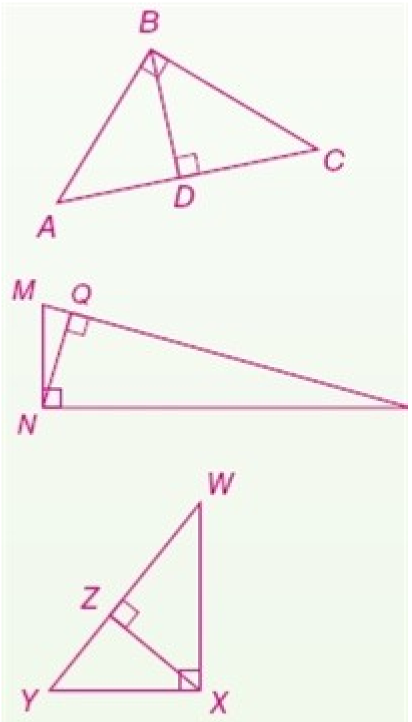
	Angle Measure					
△ABC	△ABC		△BDC		△ADB	
	ABC	90°	BDC	90°	ADB	90°
	A	47°	CBD	47°	BAD	47°
	C	43°	DCB	43°	DBA	43°
△MNP	△MNP		△NQP		△MQN	
	MNP	90°	NQP	90°	MQN	90°
	M	74°	PNQ	74°	NMQ	74°
	P	16°	QPN	16°	QNM	16°
△WXY	△WXY		△WZX		△XZY	
	WXY	90°	WZX	90°	XZY	90°
	W	38°	XWZ	38°	YXZ	38°
	Y	52°	ZXW	52°	ZYX	52°

c. Notice how the angles in each triangle formed by the altitude from the right angle vertex are the same as the original triangle. What does this mean about all three triangles?

Sample answer: The altitude originating at the right vertex of a right triangle divides the triangle into three similar triangles.

ANSWER:

a. Sample answer:



b. Sample answer are given.

	Angle Measure					
△*ABC*	△*ABC*		△*BDC*		△*ADB*	
	ABC	90°	*BDC*	90°	*ADB*	90°
	A	47°	*CBD*	47°	*BAD*	47°
	C	43°	*DCB*	43°	*DBA*	43°
△*MNP*	△*MNP*		△*NQP*		△*MQN*	
	MNP	90°	*NQP*	90°	*MQN*	90°
	M	74°	*PNQ*	74°	*NMQ*	74°
	P	16°	*QPN*	16°	*QNM*	16°
△*WXY*	△*WXY*		△*WZX*		△*XZY*	
	WXY	90°	*WZX*	90°	*XZY*	90°
	W	38°	*XWZ*	38°	*YXZ*	38°
	Y	52°	*ZXW*	52°	*ZYX*	52°

c. Sample answer: The altitude originating at the right vertex of a right triangle divides the triangle into three similar triangles.

21. **ERROR ANALYSIS** Felix and Tamara are building a replica of their high school. The high school is 75 feet tall and the replica is 1.5 feet tall. Felix says the scale factor of the actual high school to the replica is 50: 1, while Tamara says the scale factor is 1: 50. Is either of them correct? Explain your reasoning.

SOLUTION:

The scale factor of the high school and the replica can be determined by reducing the ratio of their heights:

$$\frac{\text{height of school (real)}}{\text{height of school (replica)}} = \frac{75}{1.5} = \frac{75 \div 1.5}{1.5 \div 1.5} = \frac{50}{1}.$$

Therefore, Felix is correct.

ANSWER:

Felix; sample answer: The ratio of the actual high school to the replica is $\frac{75}{1.5}$ or 50:1.

22. **CHALLENGE** You can produce a scale model of a certain object by extending each dimension by a constant. What must be true of the shape of the object? Explain your reasoning.

SOLUTION:

In order to keep each dimension proportional to the original shape, you must extend them all by the same scale factor. If the dimensions are extended by a constant value, then they must all be the same length originally. Therefore, the figure that is being extended by a constant is regular and the proportions will remain the same.

ANSWER:

Sample answer: The figure must be regular so that when each dimension is increased by a constant value, the proportion remains the same.

23. **REASONING** Sofia is making two scale drawings of the lunchroom. In the first drawing, Sofia used a scale of 1 inch = 1 foot, and in the second drawing she used a scale of 1 inch = 6 feet. Which scale will produce a larger drawing? What is the scale factor of the first drawing to the second drawing? Explain.

SOLUTION:

The first drawing will be larger because one inch on the map counts as 1 ft in reality, so 6 inches = 6 feet, 12 inches = 12 feet, etc. The second drawing is of the scale 1 in counts as 6 feet in reality, so 6 inches on the map = 6 feet. Therefore, the second map covers a bigger area in a smaller space on the map. The second drawing will be $\frac{1}{6}$ the size of the first drawing, so the scale factor is 1: 6.

ANSWER:

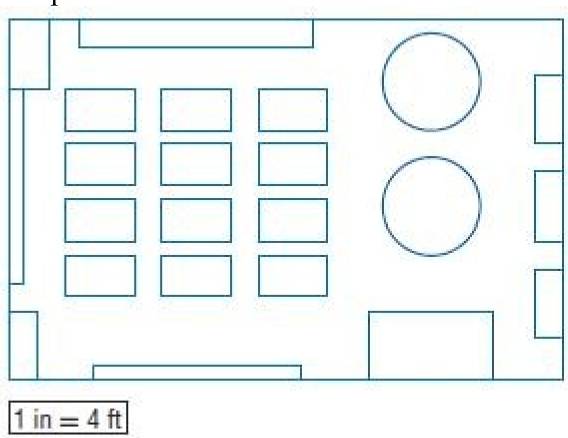
The first drawing will be larger. The second drawing will be $\frac{1}{6}$ the size of the first drawing, so the scale factor is 1: 6.

24. **OPEN ENDED** Draw a scale model of your classroom using any scale.

SOLUTION:

See students' work.

Sample answer:



ANSWER:

See students' work.

25. **WRITING IN MATH** Compare and contrast scale and scale factor.

SOLUTION:

Both can be written as ratios comparing lengths. A scale factor must have the same unit of measure for both measurements.

For example, a scale can be of the form 1 in: 4 ft, whereas a scale factor would have to simplify the scale to the same unit of measure, such as

$$1in : 4\,ft. = \frac{1\,in}{4\,ft.} = \frac{1\,in}{4 \cdot 12\,in} = \frac{1}{48}.$$

ANSWER:

Both can be written as ratios comparing lengths. A scale factor must have the same unit of measure for both measurements.

26. **SHORT RESPONSE** If $3^x = 27^{(x-4)}$, then what is the value of x?

SOLUTION:

$$3^x = 27^{(x-4)}$$
$$3^x = \left(3^3\right)^{(x-4)}$$
$$3^x = 3^{3(x-4)}$$
$$\Rightarrow x = 3(x-4)$$

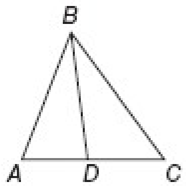
Use the distributive property on the right side.

$$x = 3x - 12$$
$$2x = 12$$
$$x = 6$$

ANSWER:

6

27. In ΔABC, $\overline{BD}$ is a median. If $AD = 3x + 5$ and $CD = 5x - 1$, find AC.



A 6
B 12
C 14
D 28

SOLUTION:

Since $\overline{BD}$ is a median, $AD = CD$. we know that it intersects the side opposite a vertex at its midpoint.

Therefore,

$$3x + 5 = 5x - 1$$
$$2x = 6$$
$$x = 3$$

Since $AC = AD + CD$, then we can substitute given values and simplify.

$$AC = 3x + 5 + 5x - 1$$
$$= 8x + 4$$

Then, since $x=3$, substitute $x = 3$:

$$AC = 8x + 4$$
$$= 8(3) + 4$$
$$= 24 + 4$$
$$= 28$$

So, the correct option is D.

ANSWER:

D

28. In a triangle, the ratio of the measures of the sides is 4: 7: 10, and its longest side is 40 centimeters. Find the perimeter of the triangle in centimeters.
F 37 cm
G 43 cm
H 84 cm
J 168 cm

SOLUTION:

Just as the ratio 4:7 is equivalent to 4x:7x , the extended ratio can be written as 4x:7x:10x. The longest side is 10x, which corresponds to the length of 40. Therefore,

$$\begin{aligned} 10x &= 40 \\ x &= 4 \end{aligned}$$

So the measures of the sides are 4(4) or 16, 7(4) or 28, and 10(4) or 40.
Perimeter = 16+ 28 + 40 = 84

So, the correct choice is H.

ANSWER:

H

29. **SAT/ACT** If Lydia can type 80 words in two minutes, how long will it take Lydia to type 600 words?
A 30 min
B 20 min
C 15 min
D 10 min
E 5 min

SOLUTION:

Let *x* be the unknown. Form a proportion for the given information.

$$\frac{x}{600} = \frac{2}{80}$$

Solve for *x*.

$$\begin{aligned} 80x &= 1200 \\ x &= 15 \end{aligned}$$

He will take 15 minutes to type 600 words.
So, the correct choice is C.

ANSWER:

C

30. **PAINTING** Aaron is painting a portrait of a friend for an art class. Since his friend doesn't have time to model, he uses a photo that is 6 inches by 8 inches. If the canvas is 24 inches by 32 inches, is the painting a dilation of the original photo? If so, what is the scale factor? Explain.

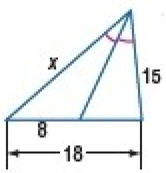
SOLUTION:

Yes; Since $\frac{24}{6} = \frac{4}{1}$ *and* $\frac{32}{8} = \frac{4}{1}$, the portrait is an enlargement of the photo and the scale factor is 4.

ANSWER:

Yes; 4; sample answer: Since $\frac{24}{6} = \frac{32}{8} = \frac{4}{1}$, the portrait is an enlargement of the photo. The scale factor is 4.

Find *x*.

31. 

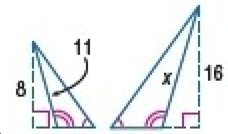
SOLUTION:

An angle bisector in a triangle separates the opposite side into two segments that are proportional to the lengths of the other two sides.

$$\frac{x}{8} = \frac{15}{18-8}$$
$$\frac{x}{8} = \frac{15}{10}$$
$$10x = 120$$
$$x = 12$$

ANSWER:

12

32. 

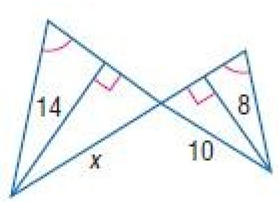
SOLUTION:

By AA Similarity, the given two triangles are similar. If two triangles are similar, the lengths of corresponding altitudes are proportional to the lengths of corresponding sides. We know that the dimensions labeled 8 and 16 are altitudes because they form right angles with the side opposite the vertex. Therefore,

$$\frac{x}{11} = \frac{16}{8}$$
$$8x = 176$$
$$x = 22$$

ANSWER:

22

33. 

SOLUTION:

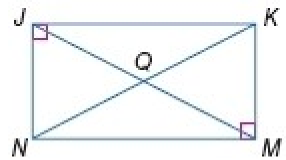
By AA Similarity, the given two triangles are similar. If two triangles are similar, the lengths of corresponding altitudes are proportional to the lengths of corresponding sides. We know that the segments marked 8 and 14 are altitudes because they are perpendicular to the side opposite of a vertex. Therefore,

$$\frac{x}{14} = \frac{10}{8}$$
$$8x = 140$$
$$x = 17.5$$

ANSWER:

17.5

ALGEBRA Quadrilateral *JKMN* is a rectangle.



34. If $NQ = 2x + 3$ and $QK = 5x - 9$, find JQ.

SOLUTION:

The diagonals of a rectangle are congruent and bisect each other. So, $NQ = QK$.

Substitute.
$2x + 3 = 5x - 9$
$-3x = -12$
$x = 4$

Substitute the value of x to find NQ.
$NQ = 2(4) + 3$
$= 11$

So, since $NQ = QK = JQ$, then $JQ = 11$.

ANSWER:

11

35. If $m\angle NJM = 2x - 3$ and $m\angle KJM = x + 5$, find x.

SOLUTION:

$m\angle NJM + m\angle KJM = 90$, since $JKMN$ is a rectangle.

Substitute.

$2x - 3 + x + 5 = 90$
$3x + 2 = 90$
$3x = 88$
$x \approx 29.3$

ANSWER:

29.3

36. If $NM = 8x - 14$ and $JK = x^2 + 1$, find JK.

SOLUTION:

Opposite sides of a parallelogram have same length. So, $JK = NM$.

Substitute.
$x^2 + 1 = 8x - 14$
$x^2 - 8x + 15 = 0$

Factor the left side.
$(x - 5)(x - 3) = 0$

By the Zero Product Property,
$x = 5$ or $x = 3$.

Substitute the value of x to find NM.

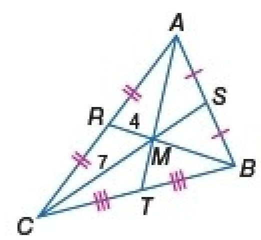
$NM = 8(3) - 14$ or $NM = 8(5) - 14$
$= 10$ or $= 26$

Since $NM = JK$, then $JK = 10$ or $JK = 26$.

ANSWER:

10 or 26

In $\triangle ABC$, $MC = 7$, $RM = 4$, and $AT = 16$. Find each measure.



37. MS

SOLUTION:

By the Centroid Theorem, $MS = \frac{2}{3}CS$.

Use the Segment Addition Postulate.

$$\begin{aligned} CM &= \frac{2}{3}CS \\ &= \frac{2}{3}(CM + MS) \\ &= \frac{2}{3}CM + \frac{2}{3}MS \end{aligned}$$

Solve for MS.

$$CM - \frac{2}{3}CM = \frac{2}{3}MS$$
$$\frac{1}{3}CM = \frac{2}{3}MS$$
$$\frac{1}{2}CM = MS$$

Substitute.

$$\frac{1}{2}(7) = MS$$

So, $MS = 3.5$.

ANSWER:

3.5

38. AM

SOLUTION:

By the Centroid Theorem, $AM = \frac{2}{3}AT$.

Substitute.

$$AM = \frac{2}{3}(16)$$
$$\approx 10.7$$

ANSWER:

10.7

39. SC

SOLUTION:

By the Centroid Theorem, $MS = \frac{2}{3}SC$.

Use the Segment Addition Postulate.

$$\begin{aligned} CM &= \frac{2}{3}CS \\ &= \frac{2}{3}(CM + MS) \\ &= \frac{2}{3}CM + \frac{2}{3}MS \end{aligned}$$

Solve for MS.

$$CM - \frac{2}{3}CM = \frac{2}{3}MS$$
$$\frac{1}{3}CM = \frac{2}{3}MS$$
$$\frac{1}{2}CM = MS$$

Substitute.

$$\frac{1}{2}(7) = MS$$

So, $MS = 3.5$.

Now, $SC = SM + MC$. Substitute.

$SC = 3.5 + 7$
$= 10.5$

ANSWER:

10.5

40. *RB*

SOLUTION:

By the Centroid Theorem, $MB = \frac{2}{3}RB$.

Use the Segment Addition Postulate.

$$MB = \frac{2}{3}(RM + MB)$$
$$= \frac{2}{3}RM + \frac{2}{3}MB$$

Solve for MB.

$$MB - \frac{2}{3}MB = \frac{2}{3}RM$$
$$\frac{1}{3}MB = \frac{2}{3}RM$$
$$MB = 2RM$$

Therefore, $MB = 8$

Now, $RB = RM + MB$. Substitute.

$RB = 4 + 8$
$= 12$

ANSWER:

12

41. *MB*

SOLUTION:

By the Centroid Theorem, $MB = \frac{2}{3}RB.$

Use the Segment Addition Postulate.

$$\begin{aligned} MB &= \frac{2}{3}(RM + MB) \\ &= \frac{2}{3}RM + \frac{2}{3}MB \end{aligned}$$

Solve for MB.

$$\begin{aligned} MB - \frac{2}{3}MB &= \frac{2}{3}RM \\ \frac{1}{3}MB &= \frac{2}{3}RM \\ MB &= 2RM \end{aligned}$$

Therefore, $MB = 8$

ANSWER:

8

42. *TM*

SOLUTION:

By the Centroid Theorem, $AM = \frac{2}{3}AT$.

Substitute.

$$\begin{aligned} AM &= \frac{2}{3}(16) \\ &\approx 10.7 \end{aligned}$$

Now, $TM = AT - AM$.

Substitute.
$TM = 16 - 10.7$
$= 5.3$

ANSWER:

5.3

Determine whether $\triangle JKL \cong \triangle XYZ$. Explain.

43. $J(3, 9)$, $K(4, 6)$, $L(1, 5)$, $X(1, 7)$, $Y(2, 4)$, $Z(-1, 3)$

SOLUTION:

Find the side lengths of each triangle.

$$\begin{aligned} JK &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(4-3)^2 + (6-9)^2} \\ &= \sqrt{1+9} \\ &= \sqrt{10} \end{aligned}$$

$$\begin{aligned} KL &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(1-4)^2+(5-6)^2} \\ &= \sqrt{9+1} \\ &= \sqrt{10} \end{aligned}$$

$$\begin{aligned} JL &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(1-3)^2+(5-9)^2} \\ &= \sqrt{4+16} \\ &= \sqrt{20} \end{aligned}$$

$$\begin{aligned} XY &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(2-1)^2+(4-7)^2} \\ &= \sqrt{1+9} \\ &= \sqrt{10} \end{aligned}$$

$$\begin{aligned} YZ &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(-1-2)^2+(3-4)^2} \\ &= \sqrt{9+1} \\ &= \sqrt{10} \end{aligned}$$

$$\begin{aligned} XZ &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(-1-1)^2+(3-7)^2} \\ &= \sqrt{4+16} \\ &= \sqrt{20} \end{aligned}$$

Each pair of corresponding sides has the same measure so they are congruent. $\Delta JKL \cong \Delta XYZ$ by SSS.

$JK = \sqrt{10}$, $KL = \sqrt{10}$, $JL = \sqrt{20}$, $XY = \sqrt{10}$, $YZ = \sqrt{10}$, and $XZ = \sqrt{20}$. Each pair of corresponding sides has the same measure so they are congruent. $\Delta JKL \cong \Delta XYZ$ by SSS.

44. $J(-1, -1)$, $K(0, 6)$, $L(2, 3)$, $X(3, 1)$, $Y(5, 3)$, $Z(8, 1)$

SOLUTION:

Find the side lengths of each triangle.

$$\begin{aligned} JK &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(0-(-1))^2+(6-(-1))^2} \\ &= \sqrt{1+49} \\ &= \sqrt{50} \end{aligned}$$

$$\begin{aligned} KL &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(2-0)^2+(3-6)^2} \\ &= \sqrt{4+9} \\ &= \sqrt{13} \end{aligned}$$

$$\begin{aligned} JL &= \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \\ &= \sqrt{(2-(-1))^2+(3-(-1))^2} \\ &= \sqrt{9+16} \\ &= \sqrt{25} \\ &= 5 \end{aligned}$$

$$\begin{aligned} XY &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(5-3)^2 + (3-1)^2} \\ &= \sqrt{4+4} \\ &= \sqrt{8} \end{aligned}$$

$$\begin{aligned} YZ &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(8-5)^2 + (1-3)^2} \\ &= \sqrt{9+4} \\ &= \sqrt{13} \end{aligned}$$

$$\begin{aligned} XZ &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(8-3)^2 + (1-1)^2} \\ &= \sqrt{25} \\ &= 5 \end{aligned}$$

Not all of the corresponding sides are not congruent so ΔJKL is not congruent to ΔXYZ .

ANSWER:

$JK = \sqrt{50},\ KL = \sqrt{13},\ JL = 5, XY = \sqrt{8},\ YZ = \sqrt{13},$ and $XZ = 5$. The corresponding sides are not congruent so ΔJKL is not congruent to ΔXYZ.

Simplify each expression.

45. $\sqrt{4 \cdot 16}$

SOLUTION:

$$\begin{aligned} \sqrt{4 \cdot 16} &= \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} \\ &= 2 \cdot 2 \cdot 2 \\ &= 8 \end{aligned}$$

ANSWER:

8

46. $\sqrt{3 \cdot 27}$

SOLUTION:

$$\begin{aligned} \sqrt{3 \cdot 27} &= \sqrt{3 \cdot 3 \cdot 3 \cdot 3} \\ &= 9 \end{aligned}$$

ANSWER:

9

47. $\sqrt{32 \cdot 72}$

SOLUTION:

$$\begin{aligned} \sqrt{32 \cdot 72} &= \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 2 \cdot 3} \\ &= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \\ &= 48 \end{aligned}$$

ANSWER:

48

48. $\sqrt{15 \cdot 16}$

SOLUTION:

$$\begin{aligned}\sqrt{15 \cdot 16} &= \sqrt{3 \cdot 5 \cdot 2 \cdot 2 \cdot 2 \cdot 2} \\ &= 4\sqrt{15}\end{aligned}$$

ANSWER:

$4\sqrt{15}$

49. $\sqrt{33 \cdot 21}$

SOLUTION:

$$\begin{aligned}\sqrt{33 \cdot 21} &= \sqrt{3 \cdot 11 \cdot 3 \cdot 7} \\ &= 3\sqrt{77}\end{aligned}$$

ANSWER:

$3\sqrt{77}$